DOCUMENT RESUME

ED 433 280 SO 031 029

AUTHOR	Fowler, Frances C.; Poetter, Thomas S.
TITLE	Framing French Success in Elementary Mathematics Curriculum and Pedagogy: Implications for American Educators.
PUB DATE	1999-04-22
NOTE	41p.; Paper presented at the Annual Meeting of the American Educational Research Association (Montreal, Quebec, Canada, April 19-23, 1999).
PUB TYPE	Reports - Evaluative (142) -- Speeches/Meeting Papers (150)
EDRS PRICE	MF01/PC02 Plus Postage.
DESCRIPTORS	*Classroom Techniques; *Comparative Education; Elementary Education; Foreign Countries; *Instructional Effectiveness; *Mathematics Achievement; *Mathematics Curriculum; *Mathematics Instruction; National Curriculum; Qualitative Research
IDENTIFIERS	Bernstein (Basil); *France; Hiebert (James); Second International Mathematics Study; Stigler (James W); Theoretical Orientation; Third International Mathematics and Science Study

ABSTRACT

A study provides a deeper understanding of teaching elementary mathematics in France. France performed creditably in mathematics on both the Second International Mathematics Study (SIMS) and the Third International Math and Science Study (TIMSS). In analyzing the French approach to teaching elementary mathematics, three theoretical frames are used: sociocultural, official policy, and classroom practice. Five questions, developed by Stigler and Hiebert (1997), were employed to provide a theoretical framework for describing French classroom instruction. Basil Bernstein's "Class and Pedagogies: Visible and Invisible," which identifies a visible pedagogy (VP) characterized by strong "classification" and strong "framing," also was used. Data were analyzed by coding them in terms of the major concepts in Stigler and Hiebert. The formal curriculum in France is not a static entity but one whose potential lies in wait of the interpretation of practitioners, students, practice, and experience. Mathematics is strongly classified and tends toward reflecting a VP. Problem solving plays a central role in the French conceptions of teaching and learning mathematics in school. Findings suggest that French success on international mathematics tests cannot be understood as resulting from the sorts of policies that U.S. politicians recommend in the wake of publicity about U.S. scores on international comparisons. The French do not use a skill and drill approach and have no high stakes mathematics examinations during elementary school. Four probable reasons for their success are: (1) use of a constructivist approach in teaching mathematics; (2) use of instructional methods that are less disadvantageous for poor and minority children; (3) skillful use of formative assessment to guide teaching; and (4) teacher recruitment and selection processes which guarantee that knowledgeable professionals teach elementary mathematics. Contains a table and 28 references. (BT)

ED 433 280

Framing French Success in Elementary Mathematics Curriculum and Pedagogy: Implications for American Educators

Frances C. Fowler and Thomas S. Poetter
Miami University, Oxford, Ohio

Presented at the Annual Conference of the American Educational Research Association
Montreal, Quebec, Canada

April 22, 1999

SO 031 029

PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL HAS BEEN GRANTED BY

Frances C. Fowler

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

1

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☑ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy

BEST COPY AVAILABLE

Introduction

In the last twenty years, two international mathematics achievement studies have caused Americans to question their approach to the teaching of mathematics. The first of these--the Second International Mathematics Study, usually referred to as *SIMS*--was conducted in 1981-82 and provoked considerable controversy when it revealed that American students were distinctly mediocre in mathematics when compared to their peers in most other countries, especially those in Asia. These findings spurred many politicians to call for changes in education policy which would supposedly improve American students' ability to perform in mathematics: more emphasis on basic skills, a longer school day and year, and proficiency tests. Almost fifteen years later, the Third International Math and Science Study (TIMSS) revealed similar findings and sparked similar calls for reform (Stedman, 1997). Fortunately, TIMSS included more than test data; a video component studied the pedagogy of mathematics teachers in Japan, Germany, and the U. S. (Stigler & Hiebert, 1997). Through the video study researchers hoped to identify some of the deeper reasons for the divergent mathematics performance of children educated in different countries. The major researchers in that study wrote:

> Setting standards for content and performance is an important first step [to improved mathematics achievement.] But student learning will not be improved merely by setting standards and holding teachers accountable. We must study directly the processes that lead to learning in the classroom, for if we do not understand these processes we will have little chance of improving them. (Stigler & Hiebert, 1997, p. 18)

This study is an attempt to provide a deeper understanding of the teaching of elementary

mathematics in France, a country which performed creditably in mathematics on both SIMS and TIMSS. We think that the French example is potentially helpful to American educators for three reasons. First, France is culturally closer to the U.S. than is Japan, the country most often held up as a model to Americans. For example, while the Japanese tend to be group-oriented, both the French and Americans tend to be individualistic--a personality trait which has numerous implications for classroom pedagogy (Hofstede, 1991). Second, like the U.S., France has a diverse population. Among Western countries, France ranks third (behind the U.S. and Canada) in the number of immigrants received since 1800. Finally, also like the U.S., France has a relatively large gap between its upper and lower classes, meaning that educators work with significant numbers of children who are not middle class. For these reasons, the French success in mathematics could be instructive to Americans, since classroom teachers in both nations grapple with similar problems.

In analyzing the French approach to teaching elementary mathematics, we use three theoretical frames. First we look at French educational practices through a sociocultural frame drawn from the work of the British sociologist, Basil Bernstein. Then we use an official policy frame taken from the work of three American scholars to identify the curriculum policy instruments and strategies used by the French. Finally, we use Stigler and Hiebert's (1997) analytical questions as a classroom practice frame to clarify the nature of French pedagogy and to situate it within the context of the TIMSS video study. At times these frames overlap, and we have therefore felt free to use them flexibly. These theoretical frameworks are presented in detail in the next section of this paper. Next, after a description of our methodology, we present our major findings. The paper concludes with a discussion of the findings and of their implications for

mathematics education in American elementary schools.

Theoretical Framework

Because theoretical frameworks for comparing curricula and pedagogies across nations are not well conceptualized, the authors drew on three different frameworks to guide their data analysis. The first framework is that of Basil Bernstein (1971, 1975, 1990, 1996), a British sociologist. Although Bernstein has not applied his theories to comparative studies of the educational systems of different countries, his students and associates have used them to guide their research in several countries of Europe and Latin America. Bernstein's theories of the structure of pedagogical discourse encompass the entire educational system, including the official curriculum adopted by the government and how that curriculum is implemented through classroom pedagogy. They also link these pedagogical devices to the class structure of society. However, since Bernstein's theories are abstract, the researchers decided to draw on two more concrete frameworks, one designed primarily for analyzing official curriculum and the other designed to analyze instruction in the mathematics classroom. The first of these was developed by Andrew Porter, Doug Archbald, and Alexander Tyree (1981). Their framework was designed to compare curriculum reforms in several American states. Their model also lends itself to comparing the policy strategies and instruments used to encourage curriculum implementation. The second was developed by James Stigler and James Hiebert (1997) to compare eighth grade mathematics lessons in the U.S., Germany, and Japan. It distinguishes different pedagogical approaches to the teaching of mathematics. Each of these frameworks will be discussed in some detail below.

Bernstein's Visible and Invisible Pedagogies. Bernstein (1971, 1975, 1990, 1996) has identified

two pedagogies used in contemporary schools. A visible pedagogy (VP)–which some might call a traditional one–is characterized by strong classification–that is, subjects are sharply distinguished from each other, and the activities of the school are largely insulated from the outside world. It is also strongly framed; the teacher, usually in response to the demands of a formal curriculum, decides what will be taught, the sequence of learning, and the pace at which new material will be presented. Pupils, on the other hand, have few choices about their activities in class. The emphasis of the VP is on the texts which the pupils create; and the criteria for evaluating those texts are explicit. VPs are supported by the old middle class, whose occupations are in the production sector of the economy. They are compatible with their child-rearing style and advantage their children. Working class children are disadvantaged by a VP, especially because they cannot master material rapidly enough to keep up with the pace. However, working class children do understand what the VP expects of them; and their parents understand the VP and thus can provide some help with it at home.

In contrast, the invisible pedagogy, or IP, is characterized by weak classification and framing. Different school subjects are often integrated across disciplinary lines, and pupils have some choices regarding their learning activities and their rate of learning. The emphasis of the IP is on the "cognitive, linguistic, affective, [and] motivational" procedures used by the learner (Bernstein, 1990, p. 71). The criteria for assessing the quality of these procedures or of the texts which the children produce are implicit and therefore unclear to the children, though not to the teacher. The IP is advocated by the new middle class, which works in agencies of symbolic control, such as the media, advertising, or education. It is compatible with their child-rearing techniques and therefore advantages their children. Working class children are even more

disadvantaged by the IP than by the VP, for neither they nor their parents understand its implicit requirements.

Porter, Archbald, and Tyree's Curriculum Policy Strategies. Porter, Archbald, and Tyree (1991) argue that there are two basic curriculum policy strategies: (1) a top-down curriculum control strategy and (2) a bottom-up empowerment strategy. Control policies usually include several elements, such as curriculum materials, frameworks, and tests. These strategies can be compared to each other on three dimensions. First, such a strategy can be more or less prescriptive. A very prescriptive strategy is specific about what processes should be used in instruction and may include a mandated textbook and tests which cover the entire curriculum. Second, a control strategy can be more or less internally consistent. As they put it, "When all policy instruments in a control strategy prescribe the same outputs and/or processes, the control strategy is internally consistent" (p. 20). Finally, a policy strategy may depend on either authority or power to motivate compliance. An authoritative policy achieves compliance through persuasion which may be based on the legal status of the policy, its consistency with professional norms, the expertise of its originators, or the charisma of its advocates. In contrast, if a policy depends on power, compliance with it is rewarded and failure to comply is sanctioned.

Empowerment strategies are newer and less well developed. However, Porter, Archbald, and Tyree (1991) identify three empowerment strategies. The first is policies to regulate teachers. These include strengthening teacher preparation programs, requiring more in-service programs, hiring teachers more selectively, and increasing the requirements for certification. All these policy strategies could be employed to improve the general quality of the teaching force. The second policy strategy is giving teachers more voice in decision making, as in site based management.

Finally, teachers can be empowered by authorizing them to conduct peer reviews of their colleagues. Although at first Porter, Archbald, and Tyree seem to imply that these two strategies are radically opposed, the authors ultimately suggest that it might be possible to combine control and empowerment strategies in a broad attempt to reform curriculum.

Stigler and Hiebert's Analysis of Mathematics Teaching. Stigler and Hiebert (1997) taped 231 mathematics lessons in 231 classes; 100 were in Germany, 50 in Japan, and 81 in the U.S. Through their coding and analyzing of these lessons, they developed five questions about the pedagogy used which permit meaningful comparisons across cultures. The first question is: What kind of mathematics is taught in a lesson? The mathematics may be advanced, typical, or elementary in relationship to the mathematics taught elsewhere. Also, it may or may not focus on deductive reasoning. The second question is: How are the mathematical concepts or procedures presented to students? The teacher may simply state them and then assign practice work. Or, on the other hand, the teacher may develop the concepts "through examples, demonstrations, and discussions" (p. 17). Next, Stigler and Hiebert ask: What are the students expected to do during the lesson? They may be asked to: (1) practice routine procedures, (2) to apply the procedures which they have learned to new situations, (3) or to invent new procedures or analyze new situations. Their fourth question relates to the teacher's role in the lesson: Does the teacher lecture directly, summarize, and/or select problems which require student thinking to move in one direction or another? Finally, they ask: How is the lesson organized? They found that in the U.S., most mathematics lessons had two phases: acquisition of a new procedure and in-class practice of that procedure under teacher supervision. In contrast, Japanese lessons focused on one or two problems which students solved; then the teacher and students shared their solutions

and discussed them. These five questions provide a useful framework for describing classroom instruction.

Methods and Procedures

This research project is a qualitative case study. Yin (1989) defines the case study as:

> an empirical inquiry that:
> - investigates a contemporary phenomenon within its real-life context; when
> - the boundaries between phenomenon and context are not clearly evident and in which
> - multiple sources of evidence are used. (p. 23)

The data come from a larger data set which Fowler gathered during eleven trips to France between 1984 and 1997. Three types of evidence were used in this study: interviews, observations, and documents. Interviews were conducted with elementary teachers, principals, inspectors, and two people involved in teacher education. Classroom instruction was observed in eleven schools in Paris and the provinces; one teacher was observed on four different occasions between 1991 and 1997. The documents analyzed included the national curriculum for elementary school, copies of the pupil dossiers maintained by teachers, a set of elementary mathematics textbooks, results from the national assessments of elementary mathematics, books and catalogues from teacher education institutions, and teacher and administrator handbooks.

Using the theoretical frameworks, we asked the following four research questions:

1. How is the formal French National elementary mathematics curriculum structured?
2. What curriculum policy strategies and instruments do the French use to implement the elementary mathematics curriculum?
3. What type of pedagogy is used to teach elementary mathematics?

4. To what extent are the official curriculum, classroom pedagogy, and the curriculum policy strategies and instruments aligned and coherent?

Data analysis was accomplished in two stages. The co-author who speaks French reduced the data by summarizing--and in some cases translating--documents into English. The interview and observation notes had been written primarily in English, but where necessary she translated French words and sentences into English. Then, using the theoretical framework, we analyzed the data by coding them in terms of the major concepts in the framework.

Findings

This section presents the major findings of our study. The presentation of the findings is organized around the research questions, which are repeated at the beginning of each subsection.

How is the formal French national elementary mathematics curriculum structured?

The formal curriculum appears as a written document upon which many have deliberated and made official decisions (Goodlad, 1979; McCutcheon, 1995). In France, a council of teachers and educational bureaucrats (all of whom have been teachers themselves) create and periodically review the country's formal curriculum for students in grades K-5. Of course, the formal curriculum is "operationalized," or put into practice by the teachers teaching it. Other forms and meanings are attached to the formal curriculum by those who "operationalize" it and even (perhaps especially) by those who "experience" it (i.e., students) (see Goodlad, 1979, p. 68; and see Erickson & Shultz, 1995).

The formal curriculum, therefore, is not a static entity, but one whose potential lies in wait of the interpretation of practitioners, students, practice, and experience. For the purpose of describing the French national curriculum for elementary mathematics as found in The Ministry of

National Education's Elementary School Curricula (1995), however, our focus is first on its formal, official nature. We will turn later in the paper to discussions of how the formal curriculum is operationalized and experienced more specifically, though the discussions will no doubt overlap somewhat.

Bernstein's (1996) conceptions of Visible Pedagogy (VP) and Invisible Pedagogy (IP) as determined by strength of "classification"categories and by strength of "framing" discourses both act as theoretical lenses for this section. A VP is connoted typically by strong classification and strong framing whereas an IP is connoted typically by a weak classification and weak framing. Though the French national curriculum is complex and varied, it tends to reflect a VP as opposed to an IP. Let's begin by examining the nature of the curriculum document and then its contents. The French national curriculum document for grades K-5 appears as a very small, handy, paperback volume. The text runs approximately 100 pages, for all of the major subjects of classroom focus in the French elementary classroom during Cycle 2 (grades K-2) and during Cycle 3 (grades 3-5) to which specific amounts of time are allotted for instruction during a typical school week. The basic structure of the elementary curriculum is provided in Table 1.

Teachers keep the national curriculum book on their desks, rarely referring to it during class time but using it as a planning and reference tool for the most part. It is a very well-known quantity to all teachers; they have studied it and have used it since their earliest days in their teacher preparation programs, whose sequences themselves are closely tied to the content contained in the national curriculum document (Morandi, 1996).

Much is at stake for teachers and the community in relationship to the formal curriculum. A collective ethos exists among teachers which supports a commitment to making sure that

Table 1. Basic Structure of the French Elementary School Curriculum

Cycle 2 (Basic Learning) Grades K-2	Cycle 3 (Deeper Learning) Grades 3-5
French--9 hours	French and foreign languages--9 hours
Mathematics--5 hours	Mathematics--5.5 hours
Discovery of the world and civic education--4 hours	History, geography, civic education, science, and technology--4 hours
Artistic and physical education--6 hours	Artistic and physical education--5 hours
*Directed studies--2 hours	Directed studies--2 hours
Weekly total: 26 hours	**Weekly total: 25.5 hours**

*Directed studies are designed to help children learn good work habits and to evaluate their work themselves.

(Based on Achddou, et al., 1996)

students are ready for the next grade. Students will be required to take tests at the end of the third and sixth grades, so grasping the concepts outlined in the national curriculum is a necessity, and ultimately the teacher's primary responsibility.

The mathematics curriculum outlined in the document takes its place in the same book alongside the other subject areas named above. But mathematics is strongly classified and therefore tends toward reflecting A VP., having its own space, its own set of goals, and its own rhetoric of purpose and importance attached to it apart from the other subject areas. The curriculum and teachers sharply distinguish mathematics from other subject areas. The curriculum and teachers treat math as a separate entity, body of knowledge, set of concepts, and set of skills. It receives its own time during the instructional week (as do the other subjects) and sequences (the French equivalent of a lesson) typically do not integrate other specific academic topics or skills into math instruction, although it would be fair to say, generally, that teachers in France are well-trained for and skillful in integrating curriculum and learning.

The French divide the mathematics curriculum into four distinct areas of focus: 1) problem-solving 2) numbers and arithmetic (sometimes referred to as calculation) 3) geometry and 4) measurement. In Cycle 2(grades K-2, Basic Learning), the math curriculum states these goals:

A focus on numbers should reinforce their [students'] discoveries about numbers and decimal numeration to the number 1,000; and, by the end of the cycle have mastered techniques of addition and be close to mastery of multiplication and subtraction. Pupils begin to learn about the organization of space; learn to recognize a few simple geometric figures; and begin to master measurements of length and weight. By teaching these things, the mathematics program in the

measurements of length and weight. By teaching these things, the mathematics program in the cycle of Basic Learning seeks to develop children's ability to do research and to think. (France. The Ministry of National Education [hereafter cited as MNE], 1995)

Problem-solving plays a central role in the French conceptions of teaching and learning math in school. The French view the ability to understand and master math concepts in numbers and arithmetic, geometry, and measurement as keys for students to be able to solve problems that are new and about which students have little previous knowledge (MNE, 1995).

Americans typically view problem solving as doing "word problems" or "story problems" which attempt to pull out and isolate a math skill for operation, or worse, to throw the student into a completely new situation without appropriate context clues or skills. In contrast, the French begin early to foster math thinking in students by teaching students to generate novel methods for organizing and addressing a problem and for creating alternative solutions. An almost progressive orientation situates their position on the place of math in students' lives inside and outside school: "Teachers must never lose sight of the fact that every new concept and technique must be based on what the children have already learned and the experiences which they have already had" (p. 4). Math skills are rarely taught in isolation from their relationship and application to authentic, life-like situations.

Generating new research questions and creating means for exploring solutions and ideas lie at the heart of the curriculum. When teachers make it possible for students to think mathematically in novel situations, students become familiar with thinking mathematically about their environment. Through the use of a student notebook for math, in which students keep precise notes on math and document their math thinking about complex, well-situated problems

from their own environment (students keep a separate notebook for each of the subject areas), the teachers keep an ongoing record and dialogue with students about math. The fusion of pedagogical approaches (such as the use of a math notebook, among others --see Poetter & Fowler, 1998) that are widely accepted and used with high levels of mastery with tight, clearly stated curricula and goals makes for a professional and rewarding situation for teachers and for an exciting and stimulating learning agenda for students.

In Cycle 3 (grades 3-5, Deeper Learning), students:

Consolidate and prolong their previously mastered knowledge of whole numbers and discover new sorts of numbers: decimal numbers and fractions. They master the operations of multiplication and subtraction and discover division. They develop early notions of numerical functions, especially as they learn about situations involving proportions. In the area of geometry, pupils round out their knowledge of geometric objects, practice tracing them and learn to manage different tools. In the area of measurement, they consolidate and extend their competence (MNE, 1995).

As with the curriculum for Cycle 2, which mentions the import of a close "liaison" with preschool education and educators, the curriculum for Cycle 3 discusses the import of a close relationship between parties and programs in the middle school. Communication and care for the individual student and for the continuity of curricula for students constitutes a set of primary concerns for French educators.

In terms of Bernstein's framework for the purpose of reflecting on the nature and content of the math curriculum for Cycles 2 and 3, the curriculum document itself carries a strong classification for mathematics. But the public education system allows for great professional

freedom on the part of teachers and schools to create the pedagogy through which the curriculum is taught. In a sense, the strong classification of math allows the possibility of discourses in classrooms to weigh in counterbalance. But it would be inaccurate to say that the math curriculum reflects a weak framing, for the French do typically foster a strong "regulative" discourse and a strong "instructional" discourse in their teacher training programs and in elementary classrooms. Framing, as a concept, "regulates relations within a context, it refers to relations between transmitters and acquirers where acquirers acquire the principle of legitimate communication" (Bernstein, 1996, p. 27).

The French public educational system propagates a firm set of social order rules through its curriculum and pedagogy, forming what Bernstein calls a "regulative" discourse, which "refer[s] to the forms that hierarchical relations take in the pedagogic relation and to expectations about conduct, character, and manner" : In French classrooms, students are expected to be attentive, conscientious, industrious, careful, and receptive (Bernstein, 1996, p. 27). Any amount of classroom observation or reading in the literature on French classrooms would confirm that these rules are held and taught in school and that this "regulative" discourse is strongly framed. But the students are also encouraged through the formal curriculum and through teacher pedagogy "to be creative, to be interactive, and to attempt to make his or her own mark" (p. 28). These aspects of regulative discourse suggest a weaker framing, though just who is in "control" of the discourse and at what time are very complicated questions. Our observations and conclusions about there being aspects of weaker framing of regulative discourse stands in contrast to others' notable conclusions about French classrooms (cite Broadfoot, Osborne, & Sharpe). What we contend is that this counterbalancing of the regulative discourse in French classrooms constitutes

a key to understanding the strength of the French educational system and its fostering of high achievement in math. In short, while the regulative discourse is strongly framed, it allows for student voice and interaction in ways that are both educationally helpful for student achievement in mathematics as well as for the student's healthy development of a sense of the self as part of French culture and society.

It seems clear that the "instructional" discourse is also strongly framed in the French curriculum and in classrooms. The framing of instructional discourse refers to who controls what in terms of 1) the selection of the communication; 2) its sequencing; 3) its pacing; 4) the criteria; and 5) the control over the social base which makes this transmission possible (Bernstein, 1996, p. 27). The National Ministry of Education created the curriculum. As its agents, public school teachers have primary responsibility for selecting the communication, sequencing ideas (the French call lessons "sequences"), and pacing the material and teaching. Embedded in their work is the transmission of social rules and discourses about appropriate behavior and effort in school. Under these conditions, there seems very little evidence of any competing discourses of the acquirers (students) exercising much power. The power of transmission lies mostly outside the realm of students.

What curriculum policy strategies and instruments do the French use to implement the elementary mathematics curriculum?

The French combine Porter, Archbald, and Tyree's (1991) two basic curriculum policy strategies, using both a top-down control strategy and a bottom-up empowerment strategy. The control strategy consists primarily of a national curriculum framework, a nationally prescribed livret scolaire [school record] for each pupil, and national evaluations which are conducted early in the third

and sixth grades. The national curriculum framework for elementary mathematics is divided into two levels: kindergarten through grade 2 and grades 3-5. Each level is further subdivided into three mathematical domains: (1) numeration and arithmetic, (2) geometry, and (3) measurement. For each area, five to nine general objectives are stated: the total number of objectives for both levels and all three domains is 47. Examples of these objectives include:

> "Counting the elements in a collection expressing numbers in the decimal system." (MNE, 1995, p. xx) (grades K-2)
>
> "Representation of plane objects in space: patterns." (MNE, 1995, p. xx) (grades 3-5)

No teaching methods are prescribed, although the introduction to the framework states: "Solving problems plays a central role in the learning of mathematics by children" (MNE, 1995, p. xx), thereby encouraging teachers to focus their instruction on problems.

The livret scolaire, or school record, is an 80-page, 11.5" by 8.5" paperback booklet published by the Ministry of National Education which elementary teachers must maintain for every pupil. There are separate school records for grades K-2 and 3-5. In the school record teachers must write comments for each marking period, indicating the child's level of competence in multiple curriculum objectives. Comments are provided in nine subjects (language arts, mathematics, history, geography, civics, science and technology, art, music, and physical education) as well as in study habits and conduct. The mathematics section for the K-2 school record includes 22 objectives, divided into five categories: (1) problem solving, (2) knowledge of numbers, (3) calculation, (4) geometry, and (5) measurement. The school record for grades 3-5 includes 35 objectives, divided into the same categories. School records are sent home regularly for parents' signatures and follow each pupil from grade to grade and from school to school if the family moves (MNE, 199x).

The third curriculum policy instrument is the national evaluation of third and sixth graders. This test, in use since 1989, assesses pupil performance only in French and mathematics. Test items are related to the objectives in the national curriculum framework. In the mathematics test, the typical format of each item is to present a "mathematical situation" to the test takers, who then answer open-ended questions about it. For example, in the sixth grade test, a geometry question begins with a picture of a path drawn on graph paper, with numbers along one axis and letters along the other. The children are to give the coordinates of the starting and ending points and to draw directional arrows to show the direction of different portions of the path, filling in a chart as they do so. The purpose of the tests is both diagnostic and formative. Teachers are supposed to use the results to determine where the gaps in their pupils' knowledge are so that they can plan their instruction accordingly. Inspectors, who plan and conduct in-service education, are supposed to use test results to develop their programs (MNE, 1994). The tests are not used to determine whether pupils will be promoted to the next grade, to compare schools and teachers, or to reward or punish either schools or teachers (MNE, 1994). In other words, they are not high-stakes tests.

Using Porter, Archbald, and Tyree's (1991) criteria, then, the curriculum control strategy used in French elementary schools can be described as relatively non-prescriptive. Although general objectives are defined, teachers are free not only to choose their pedagogical methods, but also their textbooks. . .or, indeed, to decide whether to use a textbook at all. The tests do not cover the entire curriculum, but only the broad objectives for French and mathematics spelled out in the national curriculum framework. Moreover, the French control strategy depends more heavily on authority than on power. This authority seems to derive primarily from the legal status of the policy, its consistency with professional norms, and the expertise of its originators–all of whom are present or

former elementary teachers. Little, if any, use is made of power: no rewards and punishments are attached to compliance and, in fact, French teachers are evaluated only infrequently.

The second curriculum policy strategy which the French use is an empowerment strategy which draws on elements of two of the three empowerment strategies identified by Porter, Archbald, and Tyree (1991). First, they make heavy use of policies to regulate teachers. Since the late nineteenth century, France has had a national policy for selecting and educating teachers; in 1989 major reforms were implemented in order to further increase the quality of the teaching force. Currently, people who wish to become elementary teachers must first complete the licence (similar to a bachelor's degree) in an academic discipline at a university. Then, they must pass a highly competitive examination to enter the one year required program in teacher preparation offered by a University Institute for Teacher Education (I.U.F.M), a graduate school which specializes in teacher training. In practice, however, most teachers spend two years at an I.U.F.M.–the first year is devoted to taking classes related to the material on the competitive examination. Although this first year is not required, participation in it so greatly enhances one's chance of passing the examination that most prospective teachers enroll in it. Those who pass the exam then study for a second year at the I.U.F.M., taking more in-depth courses in pedagogy as well as doing their practice teaching and writing a thesis (I.U.F.M. de Lorraine, 1996; Morandi, 1996). The highly selective nature of this process was suggested in a 1996 interview with an I.U.F.M. director in eastern France. He stated that in a recent year, his I.U.F.M. had received 4,000 applications for admission to the first year of its program. Of these, they accepted 700; only one third of these passed the examination at the end of the first year. At the end of the second year, however, 98-99% of the remaining candidates were licensed to teach in French elementary schools. This means that less than 6% of the original

applicants were ultimately selected to teach.

The selection procedures and curriculum of the teacher education program are also designed to guarantee that French elementary teachers are proficient in French and mathematics, the two major subjects taught in the elementary grades. For example, half of all I.U.F.M.'s now require an admissions test as part of the process of selecting students for the first year; it is primarily a test of competence in French and mathematics (Morandi, 1996). During the first year of the I.U.F.M. program in the Lorraine region, the two courses to which the most time is devoted are French and mathematics. The competitive examination at the end of the first year includes several sections, but the first two tests–in French and mathematics–are qualifying sections. People who fail either of them fail the test, no matter how well they do on the rest of it. Finally, in the second year teacher candidates must take 530 hours of course work; of these, 48 hours are devoted to mathematics–the largest block of hours in that year. Thus, both through their selection procedures and the teacher preparation curriculum, the French guarantee that elementary teachers will be competent in mathematics.

The second empowerment strategy used in France is site-based management. French elementary principals have little power; they do not hire or evaluate their teachers and are usually teaching principals. The schools are governed by five official bodies, all of which include teachers. All teachers, along with parent and local government representatives, sit on the School Council; it adopts and evaluates the school project and also decides how to organize the school week. All teachers also sit on the Teachers' Council, which meets every quarter to make recommendations to the principal about the work of the school. In addition, each school has two Councils of the Teachers in a Cycle; one includes all the teachers in the school who teach grades K-2 and the other, all who

teach grades 3-5. These councils analyze the progress of the pupils in their cycle and recommend whether they should pass to the next cycle or not. The Educational Team includes all the professionals and parents involved in the work of an individual child or a class. It meets when a special problem requires discussion. Finally, the Pedagogical Team includes the principal, teachers, and others who work with the school (such as substitute teachers and special education consultants); it convenes as needed. Obviously, French elementary teachers spend a great deal of time in meetings. In fact, their work week requires them to devote 26 hours to classroom instruction and one hour to meetings (Achddou, et al., 1996).

What type of pedagogy is used to teach elementary mathematics?

This section will provide a general description of mathematics instruction in French elementary classrooms before analyzing the pedagogy, first in Bernstein's terms and then in Stigler and Hiebert's terms.

French teachers almost always use whole class instruction and organize each mathematics lesson as a tightly structured "sequence" of activities which grow out of an initial, problematic situation. For example, in a fifth grade class which Fowler observed in Paris, the teacher began with a discussion of the field trip which the children would soon take to Mont-St.-Michel and asked how far this historical site was from Paris. Using a map of France, its scale, and a ruler the class figured out the distance on the board. During the next hour and a half the children also: (1) recapitulated how to solve a problem involving scale, (2) discussed various real life uses of scale, (3) drew a blueprint of the classroom to scale, (4) had a half hour play time, (5) worked two problems involving scale in their notebooks, (6) had their solutions corrected by the teacher, and (7) worked the problems on the board and discussed them. Most class time was devoted to whole group discussion and

analysis of problems. The pace was rapid and the children played an active role. No textbooks were used; in fact, although elementary mathematics textbooks are published in France, observation suggests that they are rarely used.

Bernstein (1971, 1975, 1990, 1996) would consider French mathematics pedagogy highly visible. Mathematics is strongly classified, being sharply distinguished from other subjects. For example, the label "maths" appears in teachers' daily schedules, the teacher announces at the beginning of the lesson that the subject is mathematics, and the children have special notebooks for mathematics. It is also clear to the children at all times what they are to do. For example, during group work, teachers often inquire anxiously of the children: "Are you keeping up?" Children who are inattentive are quickly brought back to the task at hand. When the time comes to work individually in the mathematics notebooks, the children understand that they are to produce a solution to the problems and that, not only should they try to solve the problems correctly but also that their notebook page must be neatly presented and must conform to a particular format. The criteria for the evaluation of their work are very explicit,. The teaching is also strongly paced, with the teacher determining what the children will study and how rapidly they will progress. This strong pacing has historically been the major cause of a high rate of retention in grade. In recent years the government has sought to reduce grade retentions by adopting the three year cycles; at this time, children can be retained only at the end of a cycle and only once in each cycle. Another new policy designed to reduce grade retention is the requirement that two hours a week be spent on "directed studies." During this time, teachers can provide children who are struggling with extra help.

Although French pedagogy is, in general, strongly classified and framed, it should be pointed out that there are some elements of weak classification in the French elementary mathematics

classroom. The refusal to use any kind of ability grouping in the school or to have "fast" and "slow" groups in the classroom means that pupils of different achievement levels are weakly classified. Moreover, the emphasis on the aesthetic appearance of the notebooks suggests that mathematics and art are not as strongly classified in France as they are in the United States. This is supported by the math textbook series which was analyzed. In it, exercises in geometry often required children to develop complex and colorful geometric designs which, in some countries, would be considered art activities rather than mathematical ones (Bouquet & Wormser, 1991; Bouchet, Madeleine, Glaser, & Wormser, 1989a, 1989b, 1990a, 1990b).

Stigler and Hiebert's (1997) pedagogical questions facilitate the cross-cultural comparison of mathematics pedagogy. In answer to their first question, French mathematics instruction must be considered inductive, rather than deductive, at least in the elementary school. Children are typically given a concrete "mathematical situation" with which they work inductively to solve problems. Second, teachers develop mathematical concepts rather than simply stating them. For example, in the lesson on scale mentioned above, the teacher used numerous examples and class discussion to develop the concept of scale and relate it to proportionality. Similarly, in a lesson observed in Eastern France, a second grade teacher developed the meaning of subtraction at great length, drawing numerous collections of objects on the board and discussing with the class various ways to use them to represent subtraction. Third, French children spend most of their time in mathematics class participating with the teacher in the development of concepts. When they do seat work, they usually apply the learned procedures to new situations rather than either practicing routine procedures or inventing new ones. Next, the teacher's role includes acting as a discussion leader, selecting the sequence of problems to be studied, providing feedback to students, and--at times--lecturing or

summarizing new ideas. The structure of the lesson resembles that of the Japanese lessons analyzed by Stigler and Hiebert (1997), but with a difference. The first part of the French lesson is devoted to the development of general principles from concrete situations; then, like the Japanese, French students work a small number of problems and discuss the solutions with each other and the teacher. To what extent are the official curriculum, classroom pedagogy, and the curriculum policy strategies and instruments aligned and coherent?

In general, it can be safely stated that the French public education system functions with tight alignment and coherence. At least two policy strategies, as outlined by Porter, Archbald, & Tyree (1990),frame the French attempts to align the official curriculum, classroom pedagogy, and the policy approaches that support their coherence: control strategies and empowerment strategies (p. 19). Control strategies are top-down in nature, and operate under clear statements of what is desired in terms of outcomes against which all policy instruments, practice, and outcomes are justified (p. 19). Control strategies have at least four characteristics that give them weight: the extent to which they are more 1)prescriptive; 2) consistent; 3) authoritative; and 4) powerful, the more predictive of practice the control strategies will be (p. 20).

Empowerment strategies are bottom-up and rarely begin with a clear statement of desired outcomes (p. 19). Porter, Archbald, & Tyree (1990)focus primarily on Darling-Hammond's (1988) description of three policy instruments that serve to advance an empowerment approach: 1) the regulation of teachers; 2) teachers' professional control over decision-making; and 3) the provision for the ongoing peer review of practice (p. 21). While most of the French system can be characterized as operating under the influence of policies that employ control strategies, several avenues of policy action exist that employ empowerment strategies and

balance the penchant for control.

Porter, Archbald, & Tyree (1990) utilized "control" and"empowerment" policy strategies as theoretical frames through which to judge their utility for "achieving hard content for all students" (p. 19)in American public schools, and especially in the curriculum practices of four major states in the areas of mathematics and social studies including Texas, California, Florida, and New York. They define "hard content" as"not just the facts and skills of academic work, but understanding concepts and the interrelationships that give meaning and utility to the facts and skills" (p. 11). In terms of "hard content," the French strive for such ends, and achieve them in nearly every case on the local and national levels. They teach children more than rote knowledge but also the dispositions and skills to use knowledge to problem solve, even in novel situations.

In terms of curriculum policy for grades K-5 in mathematics, the national curriculum is prescribed by the French Ministry of Education. This represents a policy strategy of control, with the national government having the ultimate, prescriptive say about what mathematics will be taught in the public schools of France. But the depth of this control is limited. The government does not prescribe textbooks or workbooks or define the curriculum past the general outcomes outlined in the national curriculum. Rarely are textbooks or workbooks seen in use in classrooms. A national curriculum guide filled with sequence plans or suggested activities does not exist. Far from a lack of concern or support on the part of the government for teachers, the lack of curriculum materials empowers teachers to act as curricularists on a daily basis. One of the most important aspects of teachers' work is the design and implementation of the day-to-day curriculum, that which gets taught to students in classrooms through activities and projects.

Therefore, balancing the control strategy of a prescribed curriculum is the empowerment

the curriculum. Teachers and schools decide "how" the "what" of the curriculum will be taught. And as shown regarding the curriculum in action through pedagogy in section three of this paper, teachers and schools develop a deeper representation in actual classrooms through local practice of the curricular ideas outlined in the national curriculum. Therefore, concerns for the content and delivery of teaching and learning lie in a productive and well-understood tension in the culture of French education between control of the curriculum in terms of its general content and the empowerment of teachers to develop and implement that curriculum more deeply at the classroom and school level.

Another curriculum policy strategy related to the alignment and coherence of the curriculum is the system in place for the preparation of new elementary teachers (aspects of elementary teacher preparation are similar to those for secondary teachers). The selection and education of new teachers is tightly controlled by the government through the National ministry of Education. New teacher candidates are selectively screened for admission through a competitive application process which includes the judgment of the candidate's vita, college record (the teacher education programs occur "post-baccalaureate"), and, in increasing cases for some university Institutes for Teacher Education, an admissions test.

This highly selective process allows candidates (whose number is determined by the number of teaching posts open the previous year) to have the opportunity to complete the first year of study for teaching, which ends in a competitive, high stakes examination. The exam at the end of the first year tests for basic mastery of French, mathematics, and in some cases general knowledge. Only a small percentage of students taking the test advance to the latter stages of preparation for teaching. Most of those selected after the exam go on to teach (Morandi, 1995).

The curriculum for those preparing for the examination after the first year is closely aligned

with the knowledge base associated with the elementary math curriculum. Future teachers receive just a bit less time in the study of math than the study of French receives during the first year. The first year exam focuses primarily on French and math. Then the second year of preparation for those who are selected to continue consists of further instruction in math and the teaching of math as well as other subjects. Math, however, receives the most focus in terms of time during the second year. Four, 12 hour modules in math and math instruction for new teachers mirror the national curriculum: 1) Rational and Decimal Numbers; 2) Solids; 3) Problems; 4) Teaching Math in the Elementary School. This system shows a tight, controlled relationship between the curriculum and teacher preparation.

Yet as a policy strategy, the preparation of teachers balances aspects of control with aspects of empowerment. Granted, control is evident in the fact that the education of teachers occurs under the prescriptions of the National Ministry. The training is highly consistent with the future work of teaching, especially in terms of the curriculum content in the training programs resembling the content that is taught in schools. Power is exercised through the prevalence of high stakes tests in the process. But these carefully aligned strategies, supporting a systematic commitment to teaching hard content, also empower teachers through the professionalization of their work. As a highly selective field, only the most committed and able teachers make the cut. The country values teachers as professionals by only filling as many jobs as are open; no alternative routes lead to teaching in France outside this rigorous training and certification process. The voice of teachers extends to classroom and school as well; empowered by their training and valued positions, teachers exercise wide-ranging technical and professional decision-making opportunities in their classrooms and schools (Morandi, 1996; Faucon, 1996).

A third aspect of control, establishing alignment and coherence between curriculum and pedagogy, is student evaluation. The National ministry sets forth the systems for evaluating classroom students' progress and achievement in math. Three significant methods consistently control the relationship between what is taught, how it is taught, and how well students are learning.

First, teachers keep a notebook with each student in each subject area as a formative tool for checking student understanding, achievement, and progress. These notebooks are used often in class, are taken home and shared with parents, and serve as a communication link between student, teacher, and home.

Second, teachers keep a "Livret Scolaire" (school record) for each student that by law includes the results of periodic teacher evaluations, precise information about what the student has learned, recommendations made by the teacher and the cycle teachers' council about the child's placement. It is to be sent to the parents regularly for their signature and is a tool for communication between teachers as well as between parents and teachers. When children change schools, the school record should go with them (Citation?).

Third, formative examinations are given to each third and sixth grade student in math and French. These tests provide one among many indicators of student progress and do not comprise a high stakes event. The purpose of the tests is to "help teachers better identify the strengths and weaknesses of their students at the beginning of the school year" (MNE,1994, p.1). And so this control strategy exhibits an authoritative quality, seeking to establish a helpful link between student achievement in math, the curriculum, and the pedagogy that delivers the curriculum.

Discussion and Implications

It is clear from the presentation of the findings that the French success on the mathematics

tests of SIMS and TIMSS cannot be understood as resulting from the sorts of policies which American politicians usually recommend in the wake of publicity about American scores on international comparisons. The French do not use a skill and drill approach to the teaching of mathematics, they have no high stakes mathematics examinations during the elementary years, teachers and schools are not held accountable through rewards and sanctions, and the school day is not longer than that common in the U.S. And, although it is not mentioned in the findings above, the French school year is comparable in length to that of the average American state. The only policy which some Americans recommend in the wake of international comparisons and which the French do use is a national curriculum framework. Although this framework may contribute to the French success, we believe that our research suggests other factors which are at least as important and maybe more so. We feel that there are four probable reasons for the French success in international comparisons of achievement in elementary mathematics. Those four reasons are: (1) the use of a constructivist approach in teaching mathematics, (2) the use of instructional methods which disadvantage poor and minority children less than other methods which might be chosen, (3) the skillful use of formative assessment to guide teaching; and (4) teacher recruitment and selection processes which guarantee that knowledgeable professionals teach elementary mathematics. In this section we explore each of these factors in turn.

A Constructivist Approach to Teaching Mathematics

Constructivists emphasize the importance of relating new learning to prior knowledge, and the importance of immersing teaching in the world of"authentic" learning. Learning is always contextual. What is learned depends on one's prior knowledge, on the social context for learning, and on the connections between what is being learned and the real world.(Sergiovanni, 1996, p. 132)

The French national curriculum makes it clear that teachers must work to connect the world of the classroom, the subject matter at hand, and the lives of learners in order for learning to take hold and to last:"Teachers must never lose sight of the fact that every new concept and technique must be based on what the children have already learned and the experiences which they have already had" (MNE, 1995, p. 4). This essentially constructivist perspective, as viewed by most distanced observers, tends not to ring true and is subsequently misinterpreted. Common research depictions of French classrooms, at least those often advanced by the British, tend to portray French classrooms as arid and static (Broadfoot & Osborne; Sharpe). But from our perspective, based on extensive observations of French classrooms and the study of curriculum policy and practice, the interactions in French classrooms almost always build an even stronger community of learners, help students construct new knowledge, and foster deeply conceptual learning.

The reasons for the effective creation of an essentially constructivist approach within the culture of a very Visible Pedagogy (VP) lie within an array of conditions that are in place to support and extend a constructivist approach to learning math in French elementary schools. First, the curriculum itself notes the importance of teachers encountering the study of new material with students from the basis of student experience. When French students and teachers interact, lively exchanges follow. Students generate examples and ideas about new topics from their home, community, and school experiences. They are continuously assessed through tools (like the notebooks) that contain student generated examples, thoughts, theories, concepts, and skills.

Second, the social context for learning is strongly framed in French classrooms. Students focus on academic work in class; they are typically engaged in activities that throw them into study because of high interest and norms for participation and achievement. The French school day has

sufficient time for students' academic work, play, time at home, and for teachers' preparation of sequences and assessment tasks. Plenty of time and energy exist in the school day for focusing on a) the development of conceptual clarity and understanding in mathematics as well as on b) the connection of emerging knowledge and understanding with students' prior experiences, concerns, and interests.

Third, the teacher preparation programs in France focus on establishing deep knowledge of math concepts in each prospective teacher and then converting deep knowledge of subject matter into effective pedagogical approaches. They do this by narrowing the scope of the curriculum, showing teachers how good sequences work, not only in terms of"methods" or "mechanics" of teaching but also in the "artistry" of teaching and communicating. Learning to teach is not an abstract endeavor; the French have a clear conception of good teaching, make sure each and every new teacher has both the knowledge base and philosophical understanding that support good teaching, and give clear feedback on progress during practice teaching. And while the teacher controls most classroom interactions in terms of direction and pace, students interact freely by offering up their own lives and insights to connect with new conceptual ideas in mathematics. As a result, French students tend to think in the world more mathematically and do much better than American students on standardized tests because the tests ask for students to think conceptually.

The Use of Methods Appropriate for Disadvantaged Children

The national scores on the international mathematics tests are the mean score of all the children of that nationality who took the test. This means that those countries which can avoid having large numbers of children who score very poorly will have higher mean scores than those in which the bottom range of scores is very low. Since school achievement is linked with socioeconomic class,

countries like the U. S. and France--which have a higher percentage of poor children than most developed countries–are likely to find themselves at a disadvantage when compared to nations which have relatively few. We believe that some of the French success on international mathematics comparisons can be explained by policies and practices which enhance the achievement of disadvantaged children.

The first of these policies is the provision of a four year public preschool program. Readers undoubtedly noticed that Cycle 2 of the primary school includes grades K-2 and may have wondered about Cycle 1. Cycle 1 is a three year preschool which children may enter at the age of two. Although the preschool and kindergarten year are entirely optional, 30 % of French children attend an all-day preschool program by age two and more than 90% are in attendance by age three. At ages four and five, attendance is virtually universal. The French preschool and kindergarten are taught by fully certified elementary teachers and are teaching programs; although the children naturally spend a great deal of time in play, the enrichment of language and the development of rudimentary notions of mathematics are also important components of the school day. The French rationale for this highly developed educational program for young children is that they believe that it helps children from non-French speaking and poor homes enter first grade with a greater chance for school success than they would otherwise have. Indeed, they have conducted a great deal of research on the effects of the preschool program on later success in school; and their research confirms their expectations. In this respect, it is consistent with much American research. We would therefore suggest that improving the learning of American children as a whole (a much more worthy goal than merely raising test scores!) will probably require a similar commitment to quality early childhood education.

A second policy which the French use to advantage in their primary schools is heterogeneous

ability grouping. French educators strongly object to all forms of tracking at the primary (and also middle) school level on the grounds that it promotes unequal access to knowledge. Their rejection of ability grouping is so complete that they do not even divide children into small groups based on ability for instruction within the classroom. The "high," "low," and "middle" reading groups which are virtually ubiquitous in American elementary schools are rarely seen in France. Similarly, children are not grouped within the French classroom for mathematics instruction. Instead, as we have seen, French teachers use whole group instruction and expect every child to participate and to attempt to solve the problems. While this practice does mean that some children flounder and find it hard to keep up, it also means that all are exposed to challenging mathematics material. The provision of two hours a week of "directed study" does permit the teacher to provide extra practice for those who are having difficulty and may therefore compensate somewhat for the rapid pacing of the whole class instruction.

Finally, the French embed their constructivist approach to mathematics in what Bernstein (1971, 1975, 1990, 1996) has called a *visible pedagogy*. Americans often think that constructivist methods can only be used in conjunction with an invisible pedagogy which gives children many choices and never makes fully clear to pupils or their parents what the criteria for evaluation or are what will come next in the curriculum. The French way of teaching mathematics indicates that constructivism can, in fact, be effectively combined with a visible pedagogy. Since Bernstein argues that visible pedagogies are more effective with working class children than invisible ones, the use of visible pedagogy is probably yet another reason for relatively high mean scores in mathematics by French children. While we would not argue that Americans should completely abandon invisible pedagogies, we would suggest that both teachers and teacher educators in the U.S. need to master

a range of pedagogies which can be adapted to different populations and circumstances. The combination of constructivism with visible pedagogy would probably be a powerful approach to mathematics instruction for some, though not all, American children.

The Skillful Use of Formative Assessment

The prevalence of formative assessment in French education Like most other European nations, the French have pushed their high stakes, summative evaluations of student achievement back much further in time in the students' academic careers. The tests now exist only for helping determine entry into highly selective secondary schools, for which test scores are actually only one among many other measures considered. The admissions tests have been eliminated altogether for some who go on to productive high school and post-secondary education experiences. Somewhat ironically, though, they still exist in the teacher preparation cycle,"weeding out" almost 80% of those who enter the teacher preparation cycle. But in almost every French locale, high stakes tests play a much diminished role.

However, the phenomenon of decreased existence of summative assessment doesn't mean that evaluation is not alive and well in French schools. On the contrary, formative assessment strategies strongly pervade the curricular and pedagogical landscape of French education and play an integral role in strengthening the end goal of French public education in mathematics: that students will gain and generate conceptual knowledge about mathematics that is useful, practical, and theoretically sound.

In fact, three formative assessments play a crucial role in attending to the individual learning needs of students in schools:

1) Criterion-referenced tests at the end of the third and sixth grades help teachers to

know, understand, and address the potential gaps in each student's math knowledge and understanding. The test scores help teachers to teach students better; they don't serve to sort students into ability groups or classes. The French have eliminated almost all vestiges of ability grouping in classrooms, which would be considered undemocratic, and something to be avoided at all costs.

2) Each student's teachers keep a continuous "school record"which explains and interprets the student's progress and achievement in school. The document follows the student to each new class or school, and acts as a formative tool for assessing student work and ways to meet student needs. Parents or guardians get to see the record periodically, respond to its contents, and must sign it upon returning it to the school. More than a "report card," the record chronicles specific achievements in narrative form and acts as a form of communication and dialogue about the student among primary stakeholders: students, teachers, and parents. The document clearly connects the student, the curriculum, the teacher, the pedagogy, and the home together in an organic form that puts student learning and achievement in focus.

3) Each student keeps a notebook for each subject area during each year of study. The subject notebooks are daily records through which teachers can assess student comprehension and facility on a timely basis. The documents become a personal forum through which teacher and student can communicate regarding the subject area knowledge at hand. Teachers put much effort into reading and marking the notebooks, at least as much as students do in preparing them. These notebooks are living documents through which the effectiveness of teaching and learning can be judged and used to further assist the student.

Mathematically Competent Teachers

In France, the elementary mathematics lesson is an interactive event in which the teacher plays

American elementary schools, given the current tendency to emphasize strategies of curriculum control such as prescriptive curricula and high stakes tests. Therefore, it might also be necessary to simultaneously introduce more empowerment curriculum strategies, such as site-based management. Porter, Archbald, and Tyree (1991) rather cautiously raise the possibility that control and empowerment curriculum strategies can be used together. The French case demonstrates clearly that they can co-exist. However, we suspect that empowerment strategies are effective only under certain conditions. Specifically, based on the French example, we hypothesize that they can be used only with a relatively non-prescriptive curriculum framework and in the absence of high-stakes tests. We hope that future researchers in comparative education will examine the curriculum strategies of other nations to determine if, indeed, our hypothesis is correct.

Concluding Observations

The French have a great deal to teach Americans about effective teaching and learning in schools, especially through their elementary mathematics curriculum and pedagogy. With the support of a conceptually tight and focused national curriculum for mathematics, appropriate pedagogy and assessment practices, and extremely competent teachers, French students develop mathematics skills and problem-solving abilities early in their educational careers. We believe that it is probably as a result of their sound preparation in the early grades that French students consistently score higher on standardized tests in mathematics than most other Western countries. Given their success, the French experience has much to teach Americans. Undoubtedly, the practices of many other countries would be similarly instructive if they were explored in depth. We hope that future international comparisons will follow the example of TIMSS by providing insight into the mathematics curriculum and pedagogy used in the participating countries. Such an approach would be more instructive than merely

a major role as the orchestrator of a series of activities centered around a mathematical situation. Through questions, discussion, the posing of problems, and rapid feedback on student work, the teacher guides pupils toward an understanding of mathematical concepts as well as toward the ability to calculate the "answers" to mathematical exercises. What one does not see is lessons like those which Stigler and Hiebert (1997) observed in American schools and which most readers of this article well remember from their own school days--lessons in which the teacher first states a new algorithm or concept and then provides practice work in the form of numerous mathematical exercises. While the reasons for these different approaches to the teaching of mathematics are no doubt complex and include different cultural attitudes toward mathematics, one reason is extremely clear: French elementary teachers are knowledgeable about mathematics. Their high level of mathematical competence is not primarily the result of their own childhood training in school mathematics, but rather the result of a deliberate policy of selecting only people with a certain level of mathematical knowledge to enter teacher education programs and eventually be certified as elementary teachers. It is also the result of a policy of focusing on mathematics content and pedagogy in teacher education programs.

The French example suggests that one of the most effective ways to improve the teaching of mathematics in American elementary schools would be to focus on the teacher selection and education processes. If the American states adopted policies which guaranteed that only people who are competent in mathematics and comfortable discussing it, raising questions about it, and helping children explore it taught in American elementary schools, we would probably see a remarkable improvement in the mathematics achievement of American children within a generation. Of course, quite possibly people with this level of mathematical expertise would not be interested in teaching in

reporting the comparative scores–an approach which may stimulate thought about policy and practice but which provides little guidance for making meaningful changes in either.

References

Achddou, B., Jouan, Y., Reaudeau, G., Jalimi, J., Guibert, A., Cazabat, M., Lostie, G., Guillo, A., & Faucon, G. (1996). Guide de l'instituteur et du professeur d'école [Elementary teachers' guide]. Nantes, France: Hachette Education.

Bernstein, B. (1971). Class, codes, and control, Volume 1: Theoretical studies towards a sociology of language. London: Routledge & Kegan Paul.

Bernstein, B. (1975). Class and pedagogies: Visible and invisible. Paris: OECD.

Bernstein, B. (1996). Pedagogy, symbolic control and identity. London: Taylor & Francis.

Bernstein, B. (1990). The structuring of pedagogic discourse: Volume IV, Class, codes and control. London: Routledge.

Bouquet, M., & Wormser, M. (1991). Maths CP: Calcul et géométrie: Cycle des apprentissages fondamentaux [Math 1: Calculation and geometry: Cycle of basic learning]. Paris: Nathan.

Broadfoot, P., & Osborn, M. (1993). Perceptions of teaching: Primary teachers in England and France. London: Cassell.

Colin, P., Bouchet, M., Vincent, E., Glaser, P.-L., & Wormser, M. (1990a). Maths CE 1: Calcul et géométrie [Math 2: Calculation and geometry]. Paris: Nathan.

Colin, P., Bouchet, M., Vincent, E., Glaser, P.-L., & Wormser, M. (1990b). Maths CE 2: Calcul et géométrie: Cycle des approfondissements [Math 3: Calculation and geometry: Cycle of deeper learning]. Paris: Nathan.

Colin, P., Bouchet, M., Vincent, E., Glaser, P.-L., & Wormser, M. (1989a). Maths CM 1: Calcul

et géométrie [Math 4: Calculation and geometry]. Paris: Nathan.

Colin, P., Bouchet, M., Vincent, E., Glaser, P.-L., & Wormser, M. (1989b). Maths CM 2: Calcul et géométrie [Matn 5: Calculation and geometry]. Paris: Nathan.

Darling-Hammond, L. (1988). Policy and professionalism. In A. Lieberman (Ed.), Building a professional culture in schools, pp. 55-77. New York: Teachers College Press.

Erickson, F., & Shultz, J. (1995). Students' experience of the curriculum. In P. Jackson (Ed.), Handbook of research on curriculum, pp. 465-485. New York: Macmillan.

France. Ministry of National Education. Office of Evaluation and Planning. (n.d.). Évaluation CE2-6ième: Résultats nationaux septembre 1994 [Evaluations in grades 3 and 6: National results, September 1994]. Paris: Ministry of National Education.

France. Ministry of National Education. (1991a). Cycle des apprentissages fondamentaux: Cycle 2 [Cycle of basic learning: Cycle 2]. Douai, France: Imprimerie nationale.

France. Ministry of National Education. (1991b). Cycle des approfondissements: Cycle 2 [Cycle of deeper learning: Cycle 3]. Douai, France: Imprimerie nationale.

France. Ministry of National Education. (1995). Programmes de l'école primaire [Elementary school curricula]. Paris: CNDP.

Goodlad, J. (1979). Curriculum inquiry. New York: McGraw-Hill.

Hofstede, G. (1991). Cultures and organizations: Software of the mind. Maidenhead, UK: McGraw-Hill.

I.U.F.M. de Lorraine. (1996). Livret de l'étudiant et du professeur stagiaire [Catalogue for students and student teachers]. N.p.: IUFM de Lorraine.

McCutcheon, G. (1995). Developing the curriculum: Solo and group deliberation. New York:

Longman.

Morandi, F. (1996). Professeur des écoles: Entrer à l'I.U.F.M. Tôme 1 [Elementary teacher: Getting into an I.U.F.M. Vol. 1]. Paris: Nathan.

Osborn, M, & Broadfoot, P. (1992). A lesson in progress? Primary classrooms observed in England and France. Oxford Review of Education 18 (1), 3-15.

Porter, A., Archbald, D., & Tyree, A. (1990). Reforming the curriculum: Will empowerment policies replace control? In S. Fuhrman & B. Malen (Eds.), The politics of curriculum and testing, (pp. 11-36). London: Falmer Press.

Sergiovanni, T. (1996). Leadership for the schoolhouse. San Francisco: Jossey-Bass.

Sharpe, K. (1992). Catechistic teaching style in French primary education: Analysis of a grammar lesson with seven-year olds. Comparative Education 28, 249-268.

Stigler, J., & Hiebert, J. (1997, September). Understanding and improving classroom mathematics instruction: an overview of the TIMSS video study. Phi Delta Kappan 79, 14-21.

Yin, R. K. (1989) Case study research. Newbury Park, CA: Sage Publications.